EDUCTOR

Field of the Invention

This invention relates to eductors, for mixing liquids, and non-return valves for use with these eductors. This invention also relates to methods of adapting air gap eductors.

Background of the Invention

It is common practice in many industries, such as the hotel and catering industries, for chemicals such as those used for cleaning to be purchased as concentrated liquids and then diluted with water on site to give the correct concentrations for use. Proportioning dispensing apparatus have been designed to achieve the desired dilution of the concentrated solution and dispense the mixed diluted solution.

These dispensers have commonly employed so called venturi-type devices, known as eductors, to aspirate or draw the concentrated solution into the water stream.

In these eductors water travelling through a passage entrains the concentrated solution at a point where a restricted flow channel in the passage widens.

An eductor is normally arranged in an upright configuration and comprises a nozzle, for forming and directing a water jet downwards, an air gap below the nozzle, and a venturi structure located below the air gap. In use the water jet passes across the air gap and enters the venturi structure. The venturi structure comprises an inlet, a side passage for delivering a

concentrated liquid and a chamber where the concentrated liquid is entrained by the flow of water.

In order to ensure that the solution is dispensed at the desired concentration, a method of flow regulation is required to control the amount of concentrated solution drawn into the water flow. Examples of eductors, in particular eductors having means of flow regulation are described in US-A-5522419 and WO94/04857.

Typically, eductors are operated with water provided directly from the mains supply. In most water supply systems, there is the possibility of transient conditions that could create a partial vacuum inside the water lines. This may cause reverse flow of the concentrated liquids into the water supply. Clearly, this is undesirable and it is important to maintain the water supply free of contamination by preventing backflow of the chemicals into the water source.

Two types of water source protection arrangements are known. Air gap (AA) eductors have an air gap between the nozzle and the venturi structure, as discussed above. This provides back flow protection because water cannot pass back up the air gap to the water supply. Any water passing out of the venturi inlet under back flow conditions will simply spill out of the eductor without contaminating the water supply. Air gap eductors therefore provide a relatively high level of back flow protection but have a number of disadvantage which are discussed below.

Mechanical non-return valve or pipe interrupters (DB) provide a slightly lower level of back flow protection but do not have some of the disadvantages associated with air gap eductors. Known air gap eductors provide combined back flow protection and fluid dispensing in a single unit. However, air gap eductors have several drawbacks. The stream of water passing across the air gap is exposed to air, as is the nozzle directing the water. Ingress of dust or other particulates from the operating environment may interfere with the performance of the jet, which can cause increased splash back and reduce the efficiency of the venturi stage. Obstruction of the jet will prevent effective operation of the eductor. For these reasons, air gap eductors require regular maintenance. The presence of the air gap also prevents the eductor from being used with a diluent other than water, since the diluent is exposed to air.

An alternative to an air gap eductor is to use a non-return valve upstream of an eductor without an air gap. The non-return valve is positioned in series with the eductor and is a separate unit. However, in this arrangement the convenience of a combined eductor and back flow prevention unit, as provided by the air gap eductor, is lost. In addition the level of back flow protection is less than that provided by air gap eductors. Other arrangements to prevent back flow are known, for example vacuum breaker arrangements.

Summary of the Invention

The inventors have recognised that with known eductors it is not possible to switch between an air gap arrangement and a non-return valve arrangement without changing the eductor unit itself. This is expensive and time consuming. Known eductor arrangements have limited utility in so far as a single eductor cannot be used where air gap protection and non-return valve protection are required at different times.

An object of the present invention is to address the drawbacks of known eductor arrangements, in particular to provide a system that can be changed readily between an air gap arrangement and a non-return valve arrangement.

In a first aspect of the present invention there is provided an eductor comprising a venturi structure, an air gap across which in air gap operational mode a liquid jet is passed to the venturi structure and a removable non-return valve located in the air gap, whereby the eductor is convertible between air gap operational mode and non-return valve operational mode.

The removable non-return valve may have any suitable non-return mechanism, e.g. selected from those known to the person skilled in the art. The removable non-return valve may be selected to provide a particular degree of back flow protection. The non-return valve may have one or more exit ports to allow fluid to vent from the eductor in the event of a back flow situation. Suitably, the removable non-return valve is constructed from material or materials resilient to chemicals that are likely to

be encountered during normal operation.

This arrangement allows the eductor to operate either as an air gap eductor or a non-return valve eductor by simply adding or removing the non-return valve. The non-return valve may be substituted for a nozzle in the eductor which provides the liquid jet across the air gap.

It is advantageous to have an eductor which can be easily converted between an air gap arrangement and a non-return valve arrangement, in e.g. a water dilution system, because the water source, flow rate and concentrated liquid may be changed during the lifetime of an eductor and so the requirements for back flow protection may also change. Thus the present invention provides an eductor having increased utility compared with known eductors because it can be used where air gap protection is required and where non-return valve back fill protection is required.

An eductor having a removable non-return valve according to the present invention may be adapted between air gap or non-return valve arrangements on site. This has significant advantages over known arrangements which cannot be adapted in this way and which would require the entire eductor arrangement to be replaced if the back flow protection requirements changed. This would normally only be carried out by a specialist technician. The present invention therefore provides savings in time and money when changing between an air gap and non-return valve arrangements.

In a second aspect of the present invention there is provided a non-return valve cartridge adapted to be removably installed in an air gap of an eductor having an air gap and a venturi inlet zone, wherein the non-return valve cartridge comprises an inlet adapted to receive water from a supply line and an outlet adapted to deliver water to the venturi inlet zone, and a non-return valve between the inlet and the outlet.

Preferably, the outlet comprises a sealing surface to provide sealing contact with the venturi inlet zone.

Preferably the inlet comprises a sealing surface to provide sealing contact with the supply line.

Preferably, the non-return valve cartridge has a core, an expandable resilient sleeve arranged around and in sealing contact with the core to prevent fluid flow between the sleeve and the core, the sealing contact being broken when the resilient sleeve is expanded, wherein the resilient sleeve is expanded by fluid pressure from the inlet.

Preferably the non-return valve cartridge comprises an outer casing arranged around the resilient sleeve to limit the extent of expansion of the sleeve and seal to the sleeve during flow from the inlet to the outlet. In this arrangement a back flow of water may pass between the outer casing and the sleeve when the path from the inlet to the outlet is closed. Preferably the outer casing comprises an aperture through which fluid may exit the non-return valve if back flow occurs.

A non-return valve cartridge according to the present invention

which can be reversibly installed in the air gap of an air gap eductor can provide a cheap and efficient way of modifying existing air gap eductors so that they operate with a non-return valve. Thus, the present invention provides the means to modify the back flow protection of an eductor and provide the advantages of non-return valve protection without the expense and inconvenience of replacing the eductor unit or installing a separate non-return valve unit.

In a third aspect of the present invention there is provided a method of adapting an air gap eductor having a venturi mixing portion and an air gap, comprising installing a non-return valve in said air gap.

It is advantageous to adapt an eductor having an air gap so that the eductor has a non-return valve because some of the disadvantages of an air gap arrangement, such as the requirement for regular maintenance, can be removed without having to replace the entire eductor or install a non-return valve unit at another point in the fluid flow line.

It is intended that the modification of an air gap eductor according to the present invention can be done by the user of the eductor and does not require a specialist technician. Thus there are substantial savings in time and money over the known approach of replacing the eductor or fitting a separate non-return valve unit.

The provision of a mechanical barrier to back flow, in the form of a non-return valve, may be particularly suitable when toxic

or harmful fluids are used in the eductor.

Brief Description of the Drawings

An embodiment of the invention is described below, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is an exploded perspective view of an eductor embodying the present invention, including a non-return valve cartridge which is an embodiment of the second aspect of the present invention.

Fig. 2 shows an exploded front view of the eductor and non-return valve of Fig. 1.

Fig. 3 shows a front view of the eductor of Figs. 1 and 2, as assembled.

Detailed Description of the Embodiment

Figs. 1 to 3 show an eductor 1 embodying the present invention, arranged in an upright position and comprising an inlet portion 2, a venturi structure 3, a main body 4 having an open ended horizontal cylindrical structure which defines an air gap 5 between the inlet portion 2 and the venturi structure 3. The venturi structure 3 comprises an inlet 6, a side passage 7 for delivering concentrated liquid to the venturi structure 3, and an outlet portion 8. The venturi structure 3 also comprises a venturi body (not shown) where mixing of the water and

concentrated liquid occurs, and bypass passages (not shown) for liquid flow around the venturi body. The venturi structure 3 is conventional and need not be described in detail here.

Fig. 1 also partially shows a water supply conduit 10 which delivers water to the eductor 1. The conduit 10 includes a manually operable shut-off valve 11 in a conventional manner and a connection pipe 12 which is lockable into the inlet portion 2 by a bayonet fitting.

In its air gap operational mode without the non-return valve 19 described below, the inlet portion 2 contains, in conventional manner, a nozzle (not shown) which is sealed to the connection pipe 12 and directs a jet of water across the open air gap to the inlet 6 of the venturi structure 3.

A removable non-return valve 19 is shown in an exploded view in Fig. 1 and in use is located within the main body 4, in the air gap 5 (as shown in Fig. 3).

The non-return valve 19 comprises a core structure 20, a reversibly expandable resilient sleeve 25 acting as the valve member and an outer casing 26. The core structure 20 has an inlet tube 21 in an upper part for receiving water from the water supply conduit 10, an elongate stem 22 extending below the inlet 21 and fluid outlets 23 (see Fig. 3) between ribs 24 connecting the inlet tube 21 and the elongate stem 22.

The expandable sleeve 25 is made from a rubber material, such as a silicone rubber, and covers the elongate stem 22 and the outlets 23 of the core structure 20 when the valve is assembled. When the valve is assembled and there is no

pressurized water flow into the inlet tube 21, the sleeve 25 fits tightly around and is in sealing contact with the elongate stem 22 so that fluid cannot pass between the sleeve 25 and the elongate member 22.

The outer casing 26 comprises a main body 27 made from a rigid plastics material with a reinforcing helical rib 27a, vents 28 to allow fluid to pass from inside the outer casing into the air gap 5 when the valve is assembled and located in the air gap, and an outlet tube 29 for engaging the venturi inlet 6. When the valve is assembled the outer casing surrounds the expandable sleeve 25 and core structure 20.

The inlet tube 21 of the non-return valve 19 has two O-rings 21a by which it seals to the connection pipe 12 when inserted therein. The outlet tube 29 has an O-ring 29a by which it seals to the inlet 6 of the venturi structure 3 when inserted therein. The non-return valve cartridge is inserted into the eductor to correct it from air gap operational mode to non-return valve operational mode by uncoupling the supply 10 from the inlet portion 2, removing the water jet nozzle (not shown) from the inlet portion 2, inserting the valve 19 into and through the inlet portion so that the outlet tube 29 enters the inlet 6, and reconnecting the supply 10 to seal it to the inlet tube 21. The upper end of the outer casing 26 in the assembled state presses the flange 25a of the sleeve 25 against the lower end of the inlet tube 21 to make a seal at this point.

In use a flow of water enters the inlet tube 21 from water

supply 10 and exits the tube through the outlets 23. The pressure of water causes the resilient sleeve 25 to expand away from the elongate stem 22. This expansion provides a flow pathway between the sleeve 25 and the stem 22. The sleeve 25 expands to meet the main body 27 of the outer casing 26, which limits the extent to which the sleeve 25 can expand and seals the flow path through the valve 19 from its inlet to its outlet.

As a result of the expansion of the sleeve, the water flows from the inlet tube 21 to the outlet tube 29 of the outer casing. The outlet tube 29 creates a water jet directed into the venturi inlet 6 to cause entrainment of concentrated liquid supplied via the side passage 7 in the venturi in a known manner. Finally, the water and entrained liquid exit the eductor at outlet portion 8.

When the flow of water is stopped, the resilient sleeve 25 contracts and fits tightly around the elongate member 22, and in sealing contact with it. This will prevent any reverse flow of water through the non-return valve 19 to the water supply 10.

If there is no flow of water into the non-return valve 19 from the water supply 10, for example where a sudden drop in pressure of the mains water supply has occurred, and reverse flow occurs within the venturi structure 3, fluid may flow from the venturi inlet 6 into the outlet tube 29 of the non-return valve 19. However, the fluid cannot pass into the water supply

because the resilient sleeve 25 is in sealing contact with the elongate member 22, as already discussed. The fluid instead passes into the space between the main body 27 and the resilient sleeve 25 and exits the non-return valve 19 through vents 28.

Fig. 3 shows the eductor with the non-return valve 19 assembled and located inside the main body 4, in the air gap 5. The vents 28 in the main body 27 of the non-return valve 19 can be seen through the open ends of main body 4. Fluid flowing out of the non-return valve 19 through vents 28, for example in the situation where a back flow occurs in the venturi structure 3, is able to pass into the air gap and exit the eductor 1 through the open ends of the main body 4.